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A Revision of the Genus Notonemoura (Plecoptera: Notonemourinae)

By I. D. McLELLAN

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Abstract

ADDITIONS to the description of *Notonemoura latipennis* Tillyard are given. A new species and a new subspecies are described. Some notes on habitat and a description of copulation in *N. latipennis* are also given.

INTRODUCTION

THE genus *Notonemoura* is of special significance in the study of Plectoptera because it is the type genus for the subfamily Notonemourinae. Although the species of this subfamily are widespread throughout New Zealand and have successfully colonised most biotopes in running water, they and their larvae have not figured greatly in collections. Consequently, until recently, little was known about *Notonemoura* apart from descriptions of the type specimen (Tillyard, 1923) and genitalia (Kimmins, 1938) of *N. latipennis*.

Family CAPNIIDAE

Subfamily NOTONEMOURINAE

Genus NOTONEMOURA Tillyard, 1923

DIAGNOSIS: *Wings*. Hindwing with 2A forked approximately two-fifths from base. Forewing with no fusion of 1A with 2A. Position of Sc fork and Rs fork variable in both wings; Rs either forking on, or a short distance distally from, transverse cord. *Pronotum*: With a characteristic dark pattern (see Fig. 13). *Male Genitalia*: With simple cerci. Ventral lobe long and stout. Subgenital plate produced to form a long upcurved ventral process which is supported ventrally by two parallel chitinised strips. Epiproct well developed and triangular from dorsal aspect. Paraprocts consist of two slender chitinised spines. Tergite X sclerotised marginally with a posterior medial notch. *Female Genitalia*: A long tapered ovipositor arises medially from sternite VIII and projects well past abdomen tip. Ovipositor with two medial dark strips; one dorsal, one ventral. *Larva*: Antennae about one-third body length. Pronotum rectangular, wider than long, with distinctive dark markings; anterior and posterior margins with fringe of bristles. Posterior margin of mesonotum with two triangular flanges. Fore and mid legs half length of hind legs. Cerci about half body length.

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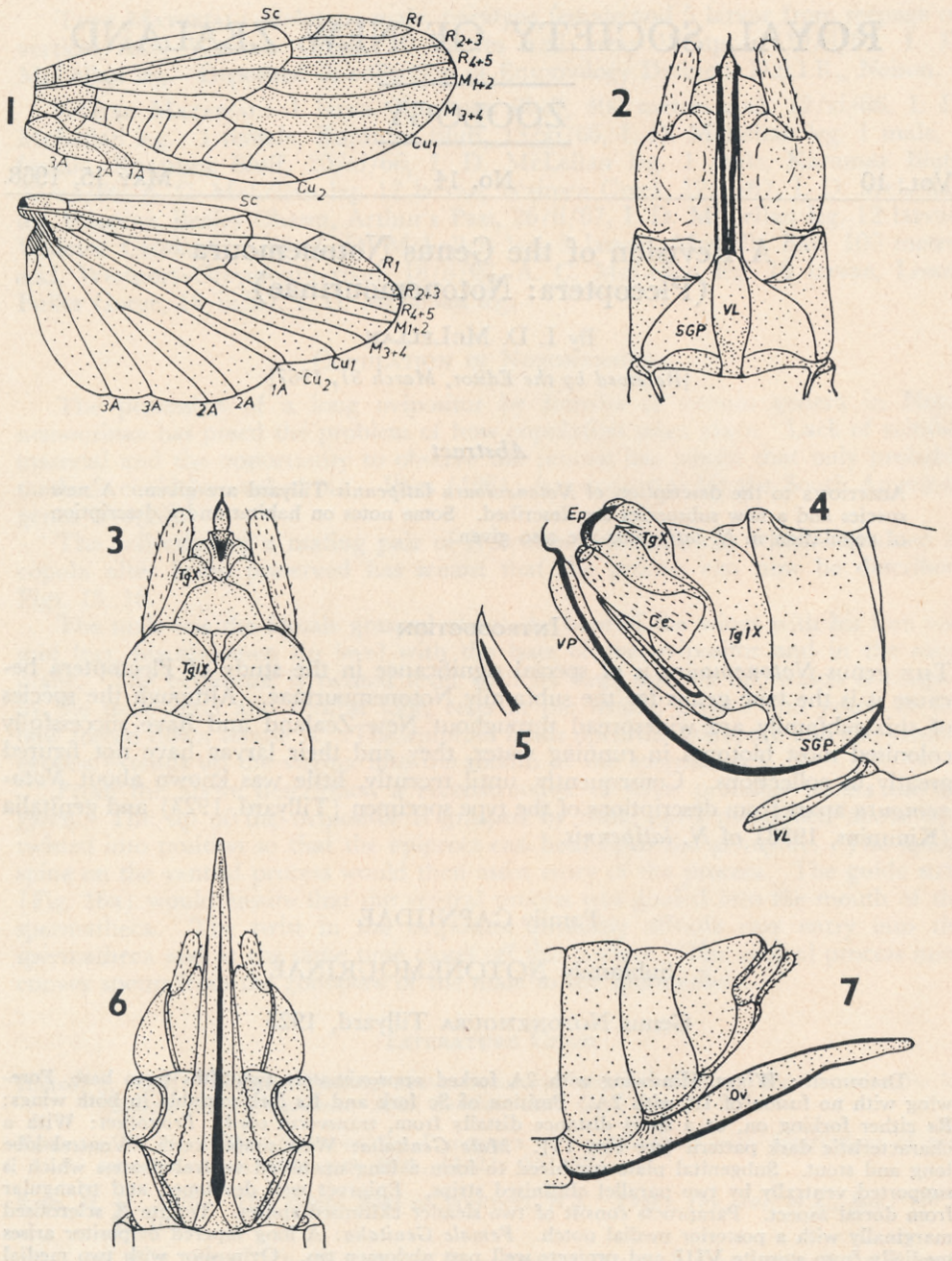


Notonemoura latipennis latipennis Tillyard. Fig. 1, Right wings. Fig. 2, Male genitalia, ventral view. Fig. 3, Male genitalia, dorsal view. Fig. 4, Male genitalia, lateral view. *Notonemoura alisteri* n.sp. Fig. 5, Male genitalia, tip of ventral process. *Notonemoura latipennis latipennis* Tillyard: Fig. 6, Female genitalia, ventral view. Fig. 7, Female genitalia, lateral view. Ce, cercus; Ep, epiproct; Ov, ovipositor; Pa, paraproct; SGP, sub-genital plate; Tg, tergite; VL, ventral lobe; VP, ventral process.

Type Species: *Notonemoura latipennis* Tillyard, 1923.

Notonemoura latipennis Tillyard, 1923

Notonemoura latipennis Tillyard, 1923, *Trans. N.Z. Inst.*, 54: 215.

Additions to Description of *N. latipennis*

Wing Venation: The author has studied more material and found that (i) Sc may fork near to or far from the costa, and (ii) Rs may fork on the transverse cord (with the base of R_{2+3} forming part of the cord), or fork distal to the cord. The venation shown in Fig. 1 is considered more representative for this species than previous figures; the darker areas are grey and the lighter areas almost hyaline.

Male Genitalia: Figs. 2, 3, 4. Epiproct heavily chitinised; triangular from dorsal aspect; laterally curved upwards and forwards, its tip terminating below tergite X. Sternite IX elongated to form a long upcurved ventral process which is strengthened ventrally by two parallel chitinised strips. Apex of process with curved spine formed from fusion of chitinised strips. Paraprocts consist of two slender chitinised spines surrounded by membranous tissue. Ventral lobe extends from anterior margin of sternite IX to base of ventral process. Tergite X sclerotised on lateral and posterior margins only; medially grooved and notched posteriorly. Tergite IX divided medially with a triangular membranous area anteriorly. Cerci short with flattened tips.

Female Genitalia: Figs. 6, 7. A long tapered ovipositor arises medially on sternite VIII and extends posteriorly well beyond abdomen tip; a black medial chitinised strip is present both ventrally and dorsally.

Measurements: Body length, male 5.5mm; female 6mm.

Forewing, male 5.5mm; female 5.5mm.
Hindwing, male 4.5mm; female 4.5mm.
Antenna, male 3.5mm; female 3.5mm.

Note: In describing *N. latipennis* Kimmins (1938) figured genitalia that are not those of this species; they belong to a new species, *N. alisteri*, that is described later in the present paper. In the original description by Tillyard (1923), the fork of 2A is not shown and the type specimen is designated as a male whereas in fact it is a female.

Description of Larva (final instar): Figs. 9, 10, 11, 12. *Head*: Eyes large and reddish brown. Ocelli prominent. Epicranium mottled brown and dark brown. Dorsal callosities dark brown. Frons brown with a V of dark brown spots anterior to median ocellus. Maxillary palp with ratio of length of segments 2:3:5:5:8. Ratio of labial palp segments 2:4:5. Mandible with teeth and molar region well developed. *Thorax*: General colour brown. Pronotum rectangular, wider than long; anterior and posterior margins with fringe of bristles; a distinct pattern of dark markings present. Mesonotum with posterior margin composed of a pair of triangular flanges; a row of bristles anteriorly at base of wingpads. *Legs*: Colour brown. Fore and mid legs much shorter than in other N.Z. genera. Hind legs twice as long as fore legs. *Abdomen*: With variable colour pattern dorsally, varying from uniform brown to brown with lighter medial markings. Cerci with all but basal segments wider distally and ringed with bristles distally.

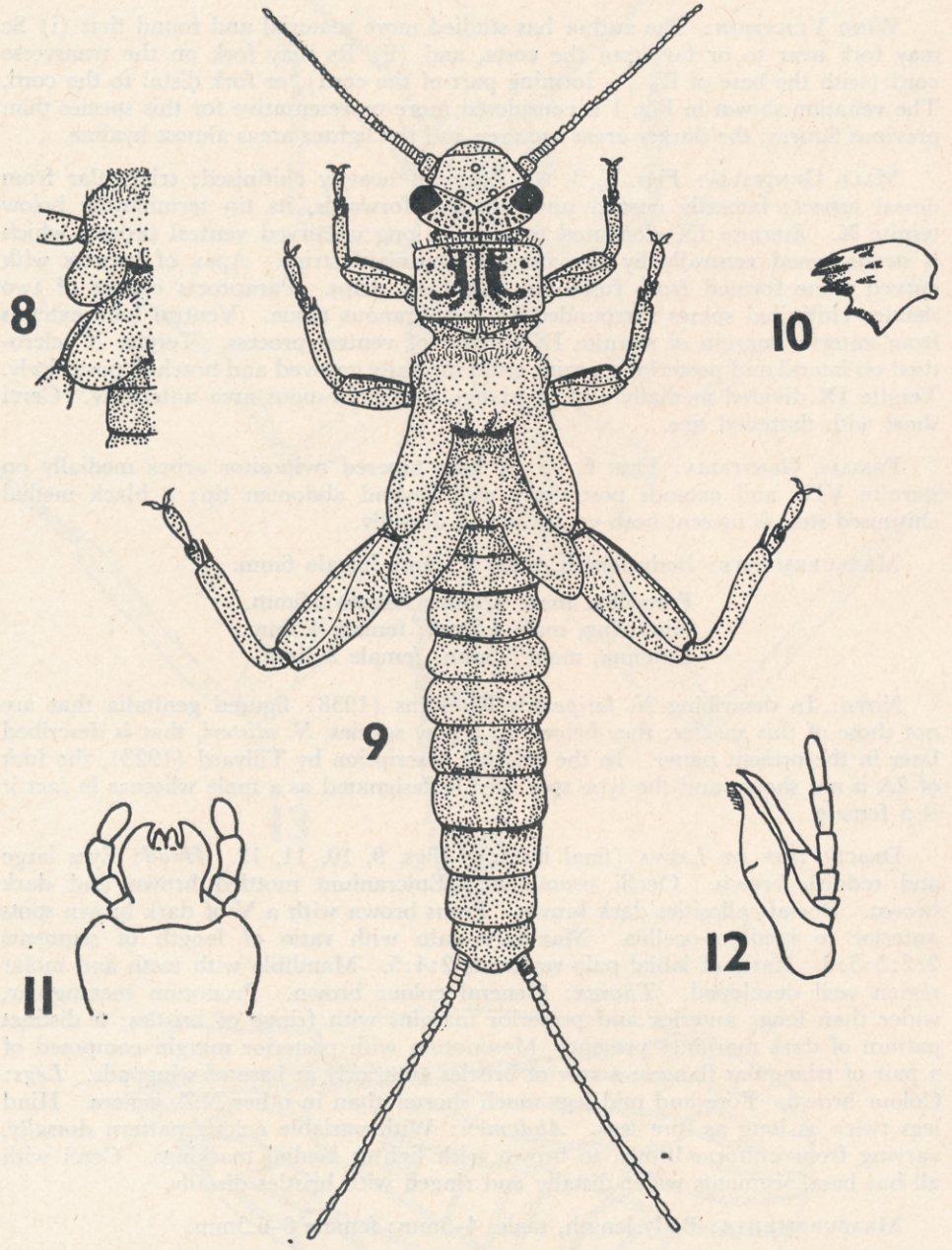
Measurements: Body length, male, 4–5mm; female 6–6.5mm.

Antenna, male 1.8mm; female 1.8mm.

Cercus, male 2mm; female 2.25mm.

Larvae of *N. latipennis* have been found in the following biotopes in alpine or sub-alpine vegetation zones.

(a) Where seepage from bogs or springs forms a thin film of water over the substratum which varies from vertical rock faces to slopes of gravel and/or soil.



Notonemoura latipennis paludis n.subsp.: Fig. 8, Larval wingpads. *Notonemoura latipennis latipennis* Tillyard; Larva: Fig. 9, Dorsal view. Fig. 10, Mandible. Fig. 11, Labium. Fig. 12, Maxilla.

(b) In small shallow bog pools with some flow of water.

(c) In small steep outflow streams from bogs.

No other stonefly larvae have been found in biotopes (a) and (b) but *Spaniocercoides* larvae inhabit the same areas in biotope (c).

Most of the material for this study was collected from 960–1,050 metres a.s.l. but the Denniston specimens were found in the usual biotopes at 600 metres a.s.l. in an unusually low area of sub-alpine vegetation which is referred to in Rigg (1962).

Material: 14 males, 11 females, 20 larvae, Mt. Augustus (960 metres a.s.l.), near Westport, 8/i/67, A. C. and I. D. McLellan leg. 6 males, 3 females, 40 larvae, Mt. Augustus, 15/i/67, A. C. and I. D. McLellan leg. 4 larvae, Denniston (600 metres a.s.l.), near Westport, 19/ii/67, I. D. McLellan leg. 8 larvae, Arthur's Pass, (960 metres a.s.l.) 26/ii/67, I. D. McLellan leg. 2 males, 4 females, and associated exuviae reared from larvae ex Mt. Augustus, 8/i/67. 11 larvae, Denniston, 4/iii/67, I. D. McLellan leg.

Notonemoura latipennis paludis, n.subsp. Figs. 8, 13, 14.

Diagnosis: Differs from *N. latipennis latipennis* by being brachypterous, wing extending to halfway of abdomen.

Description of Imago: *Head*: Antennae dark brown with short segments. Eyes large and black. Ocelli prominent. A dark brown area extends from lateral ocelli to dorsal callosities which are black. Remainder of frons light brown with some dark spots anteriorly. Epicranium mottled dark and light brown. *Thorax*: Pronotum rectangular, wider than long, brown with the distinctive generic pattern of dark markings. Meso- and metanota brown with dark brown markings anteriorly and posteriorly. *Wings*: Grey with venation thickened and each wing shortened between apex and transverse cord. In each forewing there is a tendency for Sc to end without touching R_1; a long macrotrichium arises from near base of R. *Legs*: Hind legs approx. three-quarters length of body and twice as long as fore legs. Mid and fore legs brown; hind legs brown with light brown bar medially on femora. *Abdomen*: Brown dorsally, with or without light brown markings medially. *Genitalia*: Male and female genitalia are indistinguishable from those of *N. latipennis latipennis*. See Figs. 2, 3, 4, 6, 7.

Description of Larva (final instar): Same as for *N. latipennis latipennis* apart from wingpads which are short and rounded apically. See Fig. 8.

Larvae of this subspecies were found in small shallow ponds in alpine bogs on sloping ground where there was some movement of water. No other species of stonefly larvae were seen in the same biotope.

Type Material: Holotype male, paratype female and larva deposited Entomology Division, D.S.I.R., Nelson. Paratype material consisting of 1 male, 1 female and larva deposited Canterbury Museum.

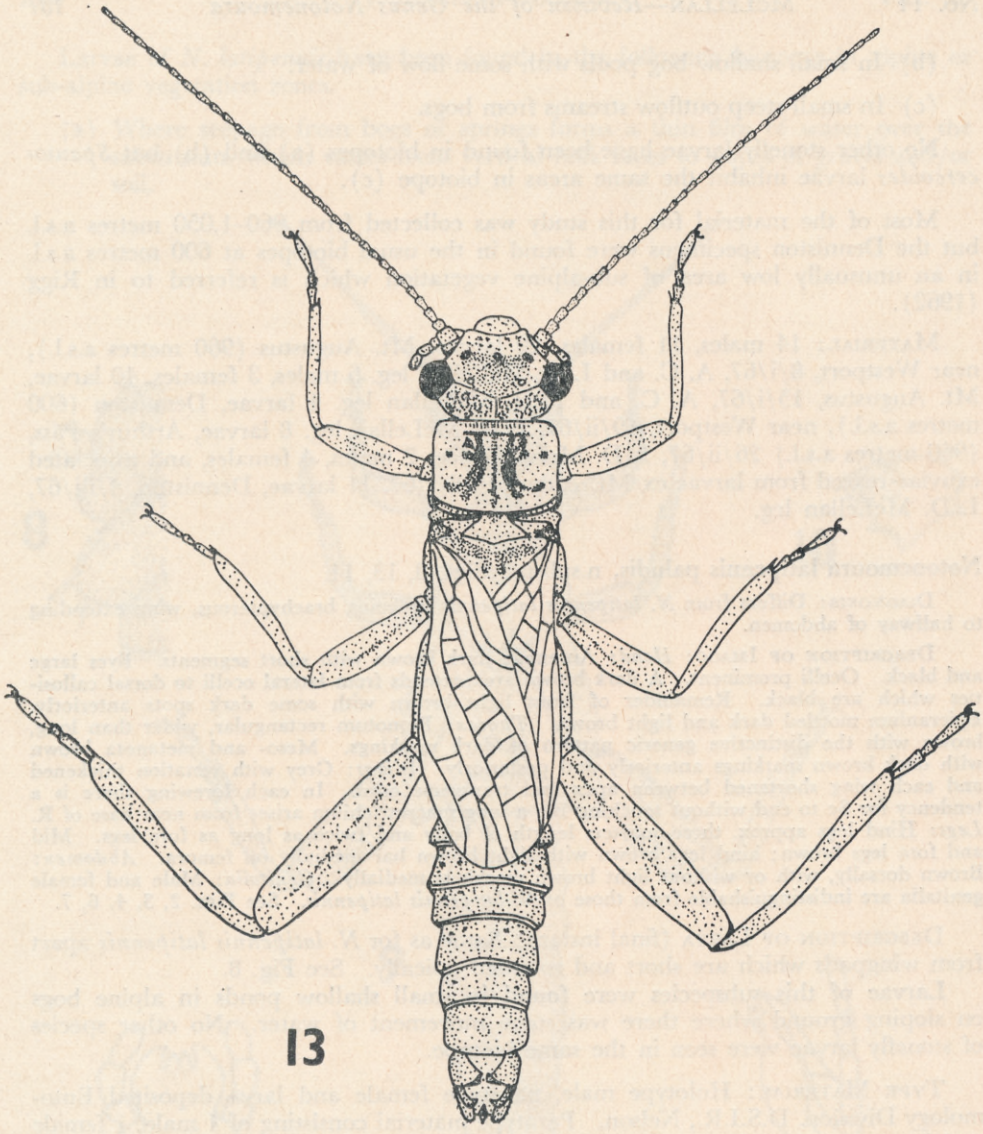
Other Material: 11 males, 4 females, 26 larvae in author's collection.

All material from 1,360 metres a.s.l. Temple Basin, Arthur's Pass, 1/i/67, I. D. McLellan, leg.

Notonemoura alisteri n.sp.

Diagnosis: Differs from the type species as follows. Imago with lighter parts of body and pterostigma of wings lime green. Legs almost uniformly light green and hind femora longer than those of type species. Ventral process of male without apical spine. Larva with lighter parts of body and legs green.

Description of Imago: *Head*: Eyes large and reddish brown. Ocelli prominent. Frons brown with a few dark brown spots anteriorly. Epicranium mottled brown and dark brown. Antennae brown basally darkening towards tips. *Thorax*: Pronotum rectangular, wider than long, with dark brown pattern of markings characteristic of genus. Thoracic sternites brown with membranous areas lime green. *Legs*: Femora and tibiae green tinged with brown. Hind legs almost as long as body. *Wings*: Wing venation as for *N. latipennis*, Fig. 1. Forewings



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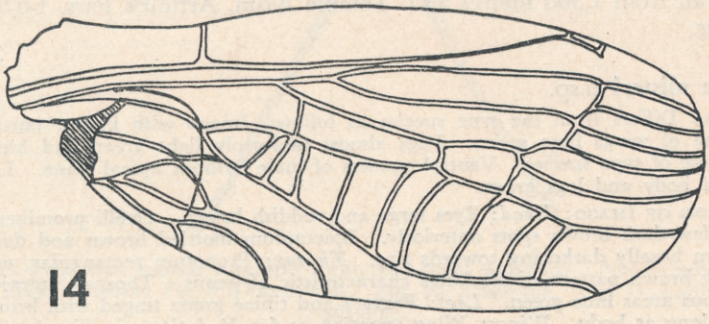

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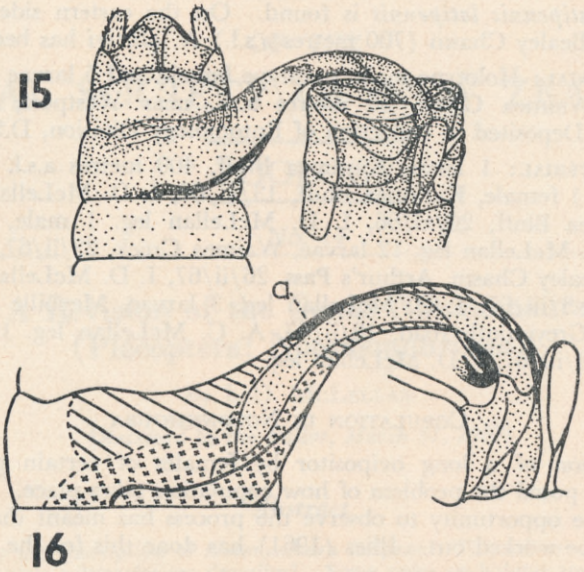
Notonemoura latipennis paludis n.subsp.: Fig. 13, Imago (male), dorsal view. Fig. 14, Forewing.



Notonemoura latipennis latipennis Tillyard: Fig. 15, Male and female genitalia in copula. Fig. 16, Male and female genitalia in copula showing detail explained in text.

light grey but darker posteriorly and basally; pterostigma lime green; R almost black; remaining veins lighter, those in basal half almost white. Hindwing dark grey with pterostigma lime green and veins dark brown. *Abdomen*: Dorsally brown but light brown ventrally with membranous areas lime green. *Male Genitalia*: Epiproct heavily chitinised; triangular from dorsal aspect; curved strongly upwards and forwards with tip below tergite X. Sternite IX produced to form a long upcurved ventral process which is strengthened ventrally by two parallel chitinised strips which terminate short of its tip and do not form an apical spine. (See Fig. 5.) Paraprocts consist of two slender chitinised spines surrounded by membranous tissue. A moderate sized ventral lobe extends level with base of cerci. Tergite X sclerotised laterally and posteriorly only; medially grooved and notched posteriorly. Tergite IX divided medially with triangular membranous area anteriorly. Cerci short with flattened tips. *Female Genitalia*: As for *N. latipennis* but lime green in colour.

Measurements: Body length, male 4–5mm; female 5–6mm.
Forewing, male 6mm; female 6.75mm.
Hindwing, male 5mm; female 5.85mm.
Antenna, male 4mm; female 4.5mm.

Description of Larva (final instar): Differs from *N. latipennis* in colour and size only. Larvae of this species are a little larger with slightly longer antennae and cerci. The same general colour pattern as in the type species but legs and lighter parts of body are green tinged with brown.

Measurements: Body length, male 5.5mm; female 6–7mm.
Antenna, male 2mm; female 2.5mm.
Cercus, male 2.7mm; female 3mm.

The imagines and larvae lose their green colouration after a short time in alcohol and then appear very similar in colour to the type species.

This species has been found only in rain forest where seepage from springs forms a thin film of water over vertical rock faces. The highest altitude at which it has been collected is 700 metres a.s.l.

Distribution of the three forms of *Notonemoura* for the Arthur's Pass area from collecting to date has resulted in the following information. *N. latipennis paludis* exists at 1,360 metres a.s.l. in Temple Basin. Below this at 960 metres a.s.l. on the

Pass itself *N. latipennis latipennis* is found. On the eastern side of the Pass, in beech forest at Bealey Chasm (700 metres a.s.l.) *N. alisteri* has been collected.

TYPE MATERIAL: Holotype male, paratype female and 5 larvae from seepage on vertical face, Waimea Creek, 50 metres a.s.l. near Westport, 19/ii/67, I. D. McLellan leg. Deposited in collection of Entomology Division, D.S.I.R., Nelson.

OTHER MATERIAL: 1 larva, Karamea Bluff, 400 metres a.s.l. 12/xi/66, I. D. McLellan leg. 1 female, Karamea Bluff, 13/xi/66, I. D. McLellan leg. 1 male, 1 female, Karamea Bluff, 20/xi/66, I. D. McLellan leg. 1 male, Karamea Bluff, 30/xii/66, A. C. McLellan leg. 12 larvae, Waimea Creek, 22/ii/67, I. D. McLellan leg. 6 larvae, Bealey Chasm, Arthur's Pass, 26/ii/67, I. D. McLellan leg. 12 larvae, Waimea Creek, 3/iii/67, I. D. McLellan leg. 3 larvae, Meybille Bay, 100 metres a.s.l. Westport–Greymouth road, 18/ii/67, A. C. McLellan leg. 10 larvae, Lower Buller Gorge, 18/iii/67, I. D. McLellan leg.

COPULATION IN NOTONEMOURA

The possession of a long ovipositor by females of certain genera in Notonemourinae has posed the problem of how copulation takes place. Lack of suitable material and the opportunity to observe the process has meant that only probable methods could be worked out. Illies (1961) has done this for the South American genus *Neofulla*.

The collection of a mating pair of *Notonemoura latipennis* which remained in copula after being preserved has meant that the process can now be described. Figs. 15, 16.

The male has the female grasped about the base of the wings with his fore and mid legs, his abdomen tip level with the base of the ovipositor and in the same plane. The ovipositor is twisted level with its base, and its tip, which is clasped by the male cerci and ventral lobe, rests in the medial groove and notch of the now forced down tergite X. The epiproct holds open the gonopore and the ventral process extends up the vagina into the mouth of the spermatheca.

From the above description a reconstruction of what probably occurs can be given. The tip of the ovipositor is grasped by those parts mentioned above and twisted into position so that the epiproct can hold open the gonopore. The apical spine on the ventral process would then assist entry of the process. The guide strip (Fig. 16a) would ensure that the ventral process was guided into the mouth of the spermatheca. The twist in the ovipositor probably affords easy entry into the spermatheca and at the same time closes off the oviduct. The ventral process must convey sperm from the gonopore of the male to the spermatheca.

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I. D. MCLELLAN,
110a Romilly Street,
Westport,
New Zealand.